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ABSTRACTS

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PHASE TRANSITIONS AND INCOMMENSURATE STATES IN DEGENERATE SYSTEMS

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The results are reported of the original investigation of various degenerate states developing in solid states, viz. charge density waves (CDW), mass density waves (MDW) and lattice distortion waves (LDW). Some new common properties of such systems have been revealed and the influence of the vibronic interaction conception on the development of studies in this field have been observed.

In some graphite intercalation compounds (GIC) below a certain temperature these occurs in the guest molecule layer a MDW which is incommensurate to graphite and transforms into a stripe domain (soliton) lattice of the mass density under cooling the GIC [1] . One of such GIC compounds is $C_{5n}HNO_3$ (where n - is a stage index) in which two-dimensional liquid-like HNO_3 layers crystallize below T_c = 250K and form an incommensurate to graphite crystal [1, 2] . On the basis of the detailed temperature investigations of $C_{5n}HNO_3$ in a soliton limit of mass density modulation we have found an unknown succession of phase transitions connected with a reorganigation in the soliton lattice of the mass density and accompanied by the concentration changes of the latter. It has been supposed that the mass density modulation and, consequently, the negative charge concentration in the intercalate layer of the GIC under consideration might, through the electron-phonon interaction, induce an instability in a graphite π -electron subsystem resulting in the formation of an inhomogeneous electron state of the CDW type with a wave vector parallel to the carbon planes or the kink lattice. The possibility of such a CDW (kink) formation mechanism in GIC confirms the discovered reversible temperature-dependent splitting in the XPS-lines of GIC C1s-electrons below T_c which testifies the presence, at least in surface layers of CDW (kinks) with the modulation amplitude up to ~ 0,8 eV under

.... Degenerate states of the LDW type have been found and studied by means of ESR in $MgBF_6 \cdot 6H_2O$ inproper ferroelastics, where B = Si (1), Ge (2) and Ti (3). As the temperature decreases from T_{i1} to T_c the lattice distortion modulation in (1) and (2) changes from a plane wave to a multisoliton type. Moreover, the transition from one modulation type to another occurs under $T_c < T_{i2} < T_{i1}$ as a result of a first-order phase transition. In (3), only soliton type distortions are realized. In (1) and (2), in a soliton limit of modulation, there have been found a succession of stepwise changes in structural soliton lattice parameters, of the $C_{5n}HNO_3$ type, accompanied by changes in crystal dielectric properties. The results reported lead to the assumption that a new property of incommensurate systems have been found which can not be unambiguously reduced to a well-known "devil's staircase" of discrete changes in modulation wave vector. In the incommensurate phase there have been found a "global" temperature hysteresis and the surface structure influence on modulation parameters, which testify to the modulation wave pinning according to the crystal defects and surface. In a plane wave limit the values of modulation parameters in (1) and (2) from T_{i2} up to T_{i1} follow the power law with the critical index $\beta = 0{,}35 \pm 0.02$, which makes it possible to consider the crystal behaviour within the Heisenberg's 3d-XY model.

It has been shown that the similarity of a number of degenerate incommensurate system properties connected with the absence of rigidity with respect to uniform variation of the order parameter phase (displacement of incommensurate "wave") which leads to the appearance of non-gap vibrations in thus spectra as well as properties characteristic of the Jahn-Teller systems.

R e f e r e n c e s

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